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Gender related difference in socioeconomic and behavioral factor in relation to blood pressure and BMI of type 2 Diabetic workers from match factories and fireworks in Sivakasi, Tamilnadu

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Abstract:
The prevalence of diabetes has been steadily increasing in workers of Match factories and Fire works in Sivakasi area. We investigated the difference between male and female diabetic patients on impact of socioeconomic, behavioural and other risk factors like blood pressure and BMI.Total 112 persons (64 male and 48 female) with type2 diabetes were selected for this study, from various hospitals situated in Sivakasi area. Socio Economic Status (SES) and other behavioural factors ascertained by physical examination and interview.

There was significant difference between male and female diabetics only in certain factors. SES was found significant and inversely related to physical activity, marital status, food habit, duration and Systolic Blood Pressure (SBP) in female diabetics. In male these association were weaker or absent when Education level was considered. But in income level significant difference found in SBP and detected age. Statistical significance found between behavioral and other risk factors in both male and female diabetics. Physical inactivity leads to high BMI and increase systolic blood pressure. Due to lack of knowledge, these diabetic patients did not avail any type of medical attention for treating diabetic till they got other complications due to untreated diabetes.

Key words: Socioeconomic, Behavioural, Blood pressure, BMI, type2 diabetes, Workers of Match factories and Fire works, Sivakasi

INTRODUCTION

Diabetes prevalence is increasing in all population groups in India, but this increase seems to be greater in lower level people. The prevalence of type 2 diabetes has been reported more in fire works and match factory workers in Sivakasi area. Socioeconomic status which plays an important role in health care and disease prevention is a complex indicator of health services accessibility, knowledge of health promotion, willingness to seek treatment and life style behaviour [1].

Educational attainments and income adequacy are important indicators of SES. Low SES tends to be associated with a high prevalence of diabetes in developed countries [2 - 4]. Obesity, physical inactivity, smoking and alcohol intake are implicated in the development of type 2 diabetes and are also associated with low socioeconomic position [5].

Research suggests an association between low socioeconomic status (SES) and high blood pressure (BP), although this association is not consistent. A study on smoking, alcohol consumption and Body Mass Index (BMI) reveals that the lifestyle increases the risk of high BP. And it is more common among people with low SES. [6 - 9]. Diagnostic and treatment services for high BP may be more accessible to people with high SES [10, 11].

The health impact of SES and behavioural factor may not be the same in male and female. Only a few studies have assessed sex difference in the relationship between SES and diabetes. The pathway by which SES may differently affect the development of type 2 diabetes in male and female are unclear. The impact of behavioural factors like BMI, Physically inactive, smoking, alcohol consumption and family history of diabetes are closely linked with insulin resistance. But the variation of BP in SES and behavioural factors has rarely been studied. So the aim of the study was to assess the sex specific association of SES, behavioural factor and the difference in BP and BMI with diagnosed type 2 diabetic workers from match factories and fireworks in Sivakasi area.

METHOD:

Area: This study was carried out on workers working in Match factories and Fire works in Sivakasi area. Sivakasi is situated in Virudhunagar district, Tamil Nadu state, India. This place is very dry and is ideally suited for the manufacturing of Fireworks, Printed materials, Paper and the Match factories. About 3500 Match factories are situated in and around Sivakasi area. Around 30,000 persons are directly employed in these factories.

Participants: For this present study 112 samples (64 male and 48 female) were collected from various hospitals situated in Sivakasi (Tamil Nadu, INDIA). The participants were interviewed and completed

questionnaires on SES and behavioural characters were collected.

Socioeconomic Variable: Information on educational attainment was divided into primary (class 1 to 5), secondary (class 6 to 10) and higher (>10th class) education and income was divided in low (< Rs. 3000), medium (Rs. 3000 to Rs. 5000) and higher level (> Rs. 5000).

Behavioural Variable: Body weight was measured in light clothing in Kg and height was measured in centimeters. BMI was calculated by weight in Kg divided by square of height in meters. Blood pressure was measured in a sitting position for 2 times at the right arm after 15 minutes rest using Sphygmomanometer by a well trained nurse.

All subjects were interviewed and asked about their physical activity. It was divided into 'active' and 'inactive'. Alcohol drinking habit was categorized as 'Alcoholic' and 'Non Alcoholic'. Cigarette smoking was divided into 'smokers' and 'Non smokers'. Their family history about diabetes was analyzed and grouped into FH+ and FH-. Their age, diabetes detected age and duration also asked during interview.

Laboratory Measurement: Plasma Glucose was measured using an enzymatic method by using ready made kit manufactured by Prison Diagnostic Pvt. Ltd. Mumbai.

Statistical Analysis: Analysis was carried out separately for male and female using Systat12 (2007) Statistical Software. Descriptive analyses were obtained for all variables and differences between male and female were assessed using t–test, x^2 tests and ANOVA. Sex differences in SES indicators were evaluated using linear or logistic regression models including original SES variables. Means [standard deviation (SD)] for normal distribution and means for log normal distributed continuous variables or proportions for categorical variables were calculated among the SES groups.

RESULT AND DISCUSSION:

Socio-economical, behavioural and other risk factors among male and female participants are shown in **Table1.** Systolic BP, Diastolic BP and BMI were higher and Blood sugar was lower among male than female. Physical inactivity was more in female compared to male. Smoking and alcohol intake was found only in male. Non- Vegetarians were more in male (81.25%) compared to female (70.81%). Family history of diabetes was seen more in male than female. Significant difference was found in Income (p=0.02) and Educational status (p=0.0008) between male and female subjects. The age at which the diabetes detected was high in male(47yrs) and low in female(44 yrs). The distributions of various risk factors by SES are shown in **Table2a&2b**. In Patients with secondary education level, more male (94.4%) members were found married than female (92.8%). In male diabetics with primary education level Single or widower was high. But for female diabetics Single or widower was high in higher education level. There was significant difference in education level and marital status among female diabetes (P=0.03).

Most of the male Non-Vegetarians were found in primary education group. But female Non-Vegetarians were more in secondary education group. While comparing income level, there was no significant difference noticed in male food habit. But in female there was a significant difference (P=0.06).

Physical inactivity was high in primary Education level and low income group in both male and female. But there was significant difference in education level (P=0.004) and income level (P=0.02) in female.

In male, Smoking habit was high in secondary education level with medium income. And there was no smoking habit among female of any education and income level. Alcohol intake was high in higher education level and high income level male. Family history of diabetes reported high among both male (30.5%) and female (42.8%) with secondary education and no significant association found in income groups.

Systolic blood pressure was more in primary educated (137 mmHg) and lower income level (139 mmHg) male. Also similar trend found in female diabetics. There was statistical significance found in Diastolic pressure in male at income level and female at education level.

Plasma glucose level was high in both male (174.9 mg/dl) and female (177.3 mg/dl) subjects with secondary education level. Male (173.3 mg/dl) diabetics with medium income and female (178 mg/dl) diabetics in lower income level had high glucose level.

Male diabetics in lower income level had high BMI 27.7 Kg/m^2. But female diabetics with primary education level had high BMI 26.9 Kg/ m^2. Diabetes detected age was high among male diabetics (54 yrs) and low among female diabetics (46 yrs) who were in low income level. And diabetic was detected very early in both the case of male and female in high income level.

Table 3a & 3b shows the relation between behavioural factors and other risk factors. Among male diabetics, significant association found between marital status and smoking habit (p=0.09). Systolic pressure in male

diabetics was more in vegetarians (135.5mmHg), smokers (135mmHg), alcoholic (134mmHg) and physically inactive (138.9 mmHg). But there was statistical significance found only in physical activity and systolic BP (p=0.003). In male diabetics, plasma glucose was more in vegetarians (175.58 mg/dl), smokers (171.86 mg/dl) and alcoholic (176. mg/dl). BMI was also more in vegetarians (27.2 Kg/m²), smokers (27.23 kg/m²) and physically inactive (27.79 kg/m²) males. But BMI showed statistical significance between smokers and non smokers (p=0.015) and physically active and inactive (p=0.01) males.

In female diabetics, Systolic BP was high in Non vegetarians (132.8 mmHg) and physically inactive (136.57 mmHg). Statistical significance (p=0.01) found between physical activity and systolic BP in female. Plasma glucose was found more in vegetarians (179.21 mg/dl) and physically active (176.22 mg/dl) female. In female diabetics, BMI showed significance (p=0.01) with physical activity, it was more (26.46 Kg/m²) in case of physically inactive female. Duration of diabetes shows significant difference between physical active and inactive female (p= 0.02).

This study shows that there is significant difference between male and female diabetics only in certain factors. In the third National Health and Nutrition Examination Survey (2001), SES was significantly associated with type 2 diabetes in both African – American and white women. But no relationship was found for men. But the patients with long standing diabetes along with severe disabling diabetic complication and poor health may result in low SES [12]. The National Population Health Survey in Canada, revealed that, low income and education remained significantly associated with self reported diabetes after controlling for BMI and physically activity in women. In men the association was weaker and did not persist after controlling for risk factors. In the present study there was significant difference in male only in few factors and SES. But female showed significant inverse association with SES [1].

The present study reveals BMI was more among low income level male diabetics. Because of the poor diet, lack of physical activity and smoking habit had lead to increase in BMI of these diabetic cases. Female diabetics in primary education level have more BMI. Lack of knowledge, consumption of junk food and sedentary life style has increased the BMI of female diabetics. The association between SES and obesity was found in several studies, obesity being stronger in women than in men. The study also revealed that an inverse association of BMI and SES was found only in women (12). It was also found in previous study that obesity is common in Indians and the adverse effect of central obesity is manifested in increasing textiles' of BMI both in men and women. BMI was found more in Indian women [13].

Physical inactivity is another major behavioural risk factor of type 2 diabetes. In US adult with physical activity was less in low SES groups [14]. But women were found with higher SES were more physically active than women with low SES; whereas this social gradient may be less pronounced in men. In KORA survey proved that physical inactivity reported more in men and women in low SES. In the present study, physical inactivity is high among both male and female diabetics who are in low income level. Physically inactive female were more in low education level. Normally well educated and those who earn more are more likely to engage in high physical activity [12].

Studies of Power and Mathews [6] identified people with high occupational status and in particular high education attainments were less likely to smoke and drink excess alcohol. Study conducted in Canada showed that lower income was inversely associated with smoking and diet intake. But in this present study there was no difference in smoking habit between education level and income level in male. Alcohol intake was more in higher income group. Because of more work, stress, body pain and work tension they may resort to take alcohol.

Kivimaki [15] identified that there was a weak inverse relationship between SES and BP. Higher education attainment was associated with lower SBP. But association involving occupational status and DBP did not reach statistical significance. Stronger links with life style and risk factor may partially explain the greater BP differences between educational levels and occupational status.

The Whitehall study found difference in SBP was no more than 3 to 5 mmHg between the highest and lowest employment grade [16] . INTER-SALT study proved an inverse association between years of education and BP [17]. He found that, for men 28 out of 47 populations and for women 38 of 47 populations, this inverse association was seen. The US Hanes III study showed no association between SES and BP. In this present study systolic BP was more in primary education and low income level in both male and female. Tension, worry about the uncertainty in life, work pressure and poor diet regulation may increase the BMI. Previous researches consistently showed a positive relationship between body weight and BP. Increased BMI was the predictor of higher BP.

The work of House [18] found that a family history of diabetes was a risk factor for diabetes in Melanesians and Indians living in Fiji. Ramachandran [13] reported a high prevalence of diabetes among Indian children

who had one or two diabetic parents. But in present study there was no significant difference in family history of diabetes and SES between male and female.

This study shows low income male diabetic had high duration of diabetes and diabetes detected age was also high. Even in female diabetics primary education group had diabetes over long duration and the detected age was high. Due to poverty and lack of knowledge these diabetic patients were not aware of the free health care facilities and never tried to avail any type of medical attention for treating diabetes, till they got complication due to prolonged untreated diabetes.

In conclusion, female diabetics SES was found significant and inversely related to physical activity, marital status, food habit, duration and Systolic Blood Pressure (SBP). In male these association were weaker or absent when Education level was considered. But in income level significant difference found in SBP and detected age. Significant difference found in both male and female behavioural character and other risk factors like SBP and BMI. Physical inactivity leads to high BMI and it increases SBP. But the difference between male and female diabetic patients needs to be further investigated.

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Table 1 Socioeconomic, Behavioural and other risk factors among male and female.

Sl No.	Factor	Male	Female	P value
1.	Age (Yrs) (Mean SD)	51.13 10.17	48.77 10.10	 0.23
2.	Diabetes detected age (Yrs) (Mean SD)	47.48 9.62	44.88 9.91	 0.17
3.	Duration (Yrs) (Mean SD)	3.67 2.37	3.92 2.67	 0.62
4.	SBP (mmHg) (Mean SD)	132.53 12.70	131.29 10.82	 0.58
5.	DBP (mmHg) (Mean SD)	80.03 8.09	79.23 6.84	 0.57
6.	Plasma Glucose (mg/dl) (Mean SD)	170.02 39.78	172.83 42.61	 0.72
7.	BMI(kg/m²) (Mean SD)	26.59 1.99	25.38 2.60	 0.0086
8.	Marital Status Married (%) Single / widow (%)	89.06 10.94	81.25 18.75	 0.24
9.	Food Habit NV (%) Veg (%)	81.25 18.75	70.83 29.17	 0.196
10.	Physically Inactive (%) Active (%)	31.25 68.75	43.75 56.25	 0.174
11.	Smoking Habit Smoker (%) Non smoker (%)	 43.75 56.25	 0 100	 0.000
12.	Alcohol intake Alcoholic (%) Non Alcoholic (%)	 45.31 54.69	 0 100	 0.000
13.	Family History of diabetes FH+ (%) FH - (%)	 76.56 23.44	 70.83 29.17	 0.49
14.	Education Primary (%) Secondary (%) Higher (%)	25.00 56.25 18.75	60.42 29.17 10.42	 0.0008
15.	Income Low (%) Medium (%) High (%)	28.13 37.50 34.37	54.17 25.00 20.83	 0.02

FH+ family history of diabetes present, FH- family history of diabetes absent, NV non vegetarian, SBP systolic blood pressure DBP diastolic blood pressure

Table: 2(a) The distribution of risk factor of type 2 diabetes by SES in men

Sl No	Factor	Male							
		Education				Income			
		Primary	Secondary	Higher	P value	Low	Medium	High	p value
1.	Marital Status Married (%) Single (%)	75.00 25.00	94.44 5.55	91.67 8.33	0.11	83.33 16.67	83.33 16.67	100 --	0.127
2.	Food Habit NV (%) Veg (%)	93.75 6.25	75.00 25.00	83.33 16.67	0.27	72.22 27.78	83.33 16.67	86.36 13.64	0.49
3.	Physically Active (%) Inactive (%)	62.50 37.50	66.67 33.33	83.33 16.67	0.46	16.67 83.33	79.17 20.83	100 --	0.000
4.	Smoking Habit Smoker (%) Non smoker (%)	43.75 56.25	44.44 55.56	41.67 58.33	0.98	38.89 61.11	45.83 54.17	45.45 54.55	0.88
5.	Alcohol intake Alcoholic (%) Non Alcoholic (%)	37.50 62.50	47.22 52.78	50.00 50.00	0.76	38.89 61.11	45.83 54.17	50.00 50.00	0.77
6.	Family History of diabetes FH+ (%) FH - (%)	6.25 93.75	30.56 69.44	25.00 75.00	0.16	27.78 72.22	16.67 83.33	27.27 72.73	0.61
7.	SBP (mmHg) (Mean SD)	137.00 13.06	130.39 13.19	133.00 9.67	NS	139.67 11.19	133.58 11.72	125.55 11.66	**
8.	DBP(mmHg) (Mean SD)	81.75 9.18	78.94 7.61	81.00 8.16	NS	83.11 7.36	81.00 8.89	76.45 6.59	**
9.	Plasma Glucose (mg/dl) (Mean SD)	166.94 48.99	174.97 35.79	159.25 38.66	NS	167.61 33.39	173.33 42.59	168.36 42.88	NS
10.	BMI kg/m² (Mean SD)	26.94 1.59	26.43 2.06	26.61 2.34	NS	27.70 2.24	26.73 1.73	25.23 1.52	NS
11.	detected age (Yrs) (Mean SD)	48.94 9.46	46.44 9.67	48.67 10.11	NS	54.11 9.37	46.00 8.80	43.68 8.15	**
12.	Duration (Yrs) (Mean SD)	3.56 2.34	3.67 2.53	3.83 2.08	NS	4.39 2.64	3.63 2.64	3.14 1.69	NS

NS- no significance ** significance p<0.01

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Table: 2(b) The distribution of risk factor of type 2 diabetes by SES in women

Sl No	Factor	Education				Income			
		Primary	Secondary	Higher	P value	Low	Medium	High	p value
1.	Marital Status Married (%) Single (%)	82.76 17.24	92.86 7.14	40.00 60.00	0.03	76.92 23.08	83.33 16.67	90.00 10.00	0.65
2.	Food Habit NV (%) Veg (%)	68.97 31.03	78.57 21.43	60.00 40.00	0.69	84.62 15.38	58.33 41.67	50.00 50.00	0.067
3.	Physically Active (%) Inactive (%)	37.93 62.07	78.57 21.43	100.00 --	0.004	30.46 61.54	75.00 25.00	80.00 20.00	0.025
4.	Smoking Habit Smoker (%) Non smoker (%)	0 100	0 100	0 100	0.0001	0 100	0 100	0 100	0.008
5.	Alcohol intake Alcoholic(%) Non Alcoholic (%)	0 100	0 100	0 100	0.0001	0 100	0 100	0 100	0.008
6.	Family History FH+ (%) FH - (%)	20.69 79.31	42.86 57.14	40.00 60.00	0.28	26.92 73.08	33.33 66.67	30.00 70.00	0.92
7.	SBP (mmHg) (Mean SD)	134.41 9.01	128.29 12.19	121.60 10.14	**	133.92 11.01	129.33 8.06	126.80 12.15	NS
8.	DBP(mmHg) (Mean SD)	80.45 7.16	78.29 6.27	74.80 5.02	**	80.27 7.41	76.33 6.14	80.00 5.58	NS
9.	Plasma Glucose (mg/dl) (Mean SD)	170.79 40.89	177.36 51.08	172.00 32.33	NS	178.00 38.22	161.08 49.62	173.50 46.38	NS
10.	BMI kg/m² (Mean SD)	26.00 2.78	24.71 2.05	23.64 1.92	NS	25.68 2.99	25.39 2.26	24.58 1.84	NS
11.	detected age (Yrs) (Mean SD)	45.97 10.38	43.86 8.58	41.40 11.46	NS	46.31 11.61	42.92 9.13	43.5 7.15	NS
12.	Duration (Yrs) (Mean SD)	4.28 3.17	3.79 1.58	2.20 0.84	***	3.96 3.21	3.83 1.69	3.90 2.28	NS

NS – no significance, ** significance $p<0.01$ *** $p<0.001$

Table 3a The relationship between behavioral & other risk factors: male

Sl No.	Factor	Food Habit			Smoker			Alcohol			Physically		
		Non Veg	Veg	P value	Yes	No	P value	Yes	No	P value	Inactive	Active	P value
1	FH+ (%) FH - (%)	21.15 78.85	33.33 66.67	0.37	25.00 75.00	22.22 77.78	0.79	31.03 68.97	17.14 82.86	0.19	70.00 30.00	79.55 20.45	0.40
2	Married (%) Single (%)	90.38 9.62	83.33 16.67	0.48	96.43 3.57	83.33 16.67	0.09	100.0	80.00 20.00	0.01	85.00 15.00	90.91 9.09	0.48
3	SBP(mmHg) (Mean SD)	131.8 13.22	135.5 10.06	0.29	135.0 8.83	130.6 14.88	0.15	134.0 110.1	131.2 13.98	0.37	138.9 10.53	129.6 12.64	0.004
4	DBP(mmHg) (Mean SD)	80.08 7.74	79.83 9.85	0.94	81.07 8.70	79.22 7.61	0.38	81.59 8.20	78.74 7.88	0.16	81.30 8.81	79.45 7.78	0.43
5	Plasma Glucose mg/dl (Mean SD)	168.7 40.36	175.5 38.36	0.59	171.8 35.02	168.5 43.57	0.74	176.7 30.08	164.4 40.83	0.21	164.3 38.19	172.6 40.65	0.43
6	BMI kg/m² (Mean SD)	26.43 1.93	27.29 2.18	0.22	27.23 1.36	26.09 2.26	0.01	26.72 1.80	26.48 2.15	0.63	27.79 1.87	26.05 1.81	0.001
7	Detected age(Yrs) (Mean SD)	46.50 9.69	51.75 8.38	0.07	47.36 8.17	47.58 10.73	0.92	47.24 8.83	47.69 10.35	0.85	55.05 5.19	44.05 9.22	0.000

Table 3b The relationship between behavioral & other risk factors: Female

Sl No.	Factor	Food Habit			Smoker	Alcoholic	Physically		
		Non Veg	Veg	P value	No	No	Inactive	Active	P value
1	FH+ (%) FH - (%)	29.41 70.59	28.57 71.43	0.95	29.17 70.83	29.17 70.83	19.05 80.95	37.04 62.96	0.17
2	Married (%) Single (%)	76.47 23.53	92.86 7.14	0.19	81.25 18.75	81.25 18.75	76.19 23.81	85.19 14.82	0.43
3	SBP(mmHg) (Mean SD)	132.8 10.72	127.5 10.50	0.13	131.2 10.82	131.2 10.82	136.5 8.42	127.1 10.82	0.001
4	DBP(mmHg) (Mean SD)	79.38 6.77	78.86 7.26	0.82	79.23 6.84	79.23 6.84	79.86 7.21	78.74 6.64	0.58
5	Plasma Glucose mg/dl (Mean SD)	170.2 41.56	179.2 46.01	0.53	172.8 42.61	172.8 42.61	168.48 38.72	176.2 45.83	0.53
6	BMI kg/m² (Mean SD)	25.49 2.80	25.12 1.93	0.61	25.38 2.60	25.38 2.60	26.46 2.86	24.54 2.07	0.01
7	Detected age Yrs) (Mean SD)	44.44 11.33	45.93 5.21	0.54	44.88 9.91	44.88 9.91	51.33 5.33	39.85 9.78	0.000